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CONTINUOUS DUST SENSORS: PROPOSED TEST METHODS

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by

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ABSTRACT

This report outlines the proposed test and calibration methods for continuous dust sensors. The units are to be calibrated in mineral, quartz, asbestos and coal dusts in the Elliot Lake dust chamber and diesel exhaust particulates in the Canadian Explosive Atmospheres Laboratory's diesel laboratory. These tests will be followed by a longer term stability test on the CONSPEC system initiated in Ottawa, and finally by tests in mines - a long term test on an underground CONSPEC system and if available in an asbestos plant (fibre specific sensor only).

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INTRODUCTION

Continuous monitoring and control systems linked to computers are being installed in mines. Many sensors and controls are desirable to enable control of the mine environment as well as mine operations. This report is concerned with the testing and calibration of airborne dust sensors. The facilities available to the Mining Research Laboratory are listed and the proposed test method and reference dust sampling methods for comparison are given in outline.

REFERENCE DUST SAMPLING METHODS

The favoured dust sampling method for assessment of the health hazard to most miners is 'gravimetric sampling'. This consists of a long period full shift respirable dust sample collected with a size selective device which rejects the coarser sized airborne dust with assessment by weighing before and after ashing, and X-ray diffraction for quartz (1).

In the Elliot Lake Laboratory the high flow, 50 L/min, Hexhlett is used as the reference gravimetric sampler. In asbestos mines and mills an optical microscope count of fibres collected on a filter method is used (2).

It would be very difficult to use the same assessment methods in continuous monitoring sensors and such sensors are likely to be dependent on the size distribution of the dust. The size distribution of airborne mineral dusts are usually similar in the finer sizes with a truncation at the upper end given by settlement or other processes (3). The diesel exhaust particulates are nearly all very fine and one can expect the major size distribution factor affecting the relationship between two types of dust samplers in most mines to be the ratio between mineral and diesel exhaust particulates.

In asbestos mines and mills there are usually three significant

components, mineral particulates (similar to other mines), diesel exhaust particulates or similar, and the particularly hazardous mineral fibres. The mineral fibres are a problem in that the optical count does not include all fibres and that the relationship between the count and the health hazard depends on the fibre diameter and length distributions. Thus a fibre specific sensor may give a better or worse estimate of the health hazard that the reference method, optical count. At present the health hazard cannot be determined, and it is desirable to determine the response of the sensor to specific length and diameters.

Size distributions of mineral dusts can be determined with the aerodynamic sampling train developed at the Elliot Lake Laboratory (4). Optical microscopy may also be required to describe particle shapes.

The size distribution of diesel exhaust particulates has been determined using electron microscopy (4). It is possible that further work may be required to specify the diesel exhaust particulates in the since chosen standard engine duty cycles.

The length and diameter of the fibres in the fibrous dust clouds will need to be determined by optical and electron microscopy. McGill University and Ontario Research Foundation are both suitable and experienced contractors for the electron microscopic determination of fibres.

TEST METHODS

LABORATORY MINERAL DUST TEST CLOUDS

Some 22 pure mineral dust clouds differing in mineral, size distribution and state of aggregation have been prepared in the Elliot Lake Laboratory dust chamber (5). Of these jet milled quartz - fine size distribution, and cyclone size selected coal - medium coarse, have since been used most often. However, others may be desirable to explore specific aspects.

Tests should be carried out over a range of concentrations at least covering 0.1 to 10 mg/m^3 of respirable dust. The Hexhlett dust sampler with its flow rate of 50 L/min is the most suitable 'reference' size selective gravimetric sampler. Size distribution determinations should be made.

LABORATORY FIBROUS DUST TEST CLOUDS

The Elliot Lake Laboratory has in the past prepared four types of glass fibre and asbestos dust clouds (5). But the supply of asbestos has all been used and no replacement found. However, the laboratory has recently purchased the fluidized bed disperser developed by Spurny (6) and standard fibrous dust cloud preparation techniques have yet to be developed.

LABORATORY DIESEL EXHAUST PARTICULATE TEST CLOUDS

There is a chamber fed by diesel exhaust particulates obtainable at a range of dilutions to match mine conditions available at CEAL's diesel test facility. Tests should be carried out at all the diesel engine standard duty cycles with at least three dilution ratios covering the practical range found in mines.

LABORATORY LIFE TRIALS

When a monitoring system with on-line computer is available in the laboratory tests should be run for one month in room air and one month in the diesel exhaust test chamber if applicable. Comparison runs with gravimetric samplers should be made at least weekly.

MINE LIFE TRIAL

The continuous monitor should be run for one year on a system installed underground.

The tests should examine:

zero drift,

calibration stability, both diesel and mineral dust,

cleaning requirements,

performance.

ASBESTOS MINE AND INDUSTRY TESTS

A fibre specific sampler should be compared with other samplers in many industrial situations; these tests clearly require the cooperation of industry and the extent of tests will depend on the willingness of industry to carry out much of the field work.

REFERENCES

1. Knight, C., "Mine dust sampling system - CAMPEDS"; CANMET Report 78-7; CANMET, Energy, Mines and Resources Canada; 1978.

2. Anon. "Determination of airborne inorganic fibre concentrations in work-places by light microscopy (membrane filter method)"; Draft International Standard ISO/DIS; 1980.

3. Knight, G., "Generation and control of mine airborne dust"; CANMET Report 80-27E; CANMET, Energy, Mines and Resources Canada; 1980.

4. Knight, G. et al., "The size distribution of airborne dust in mines"; Proc Int Symp on Aerosols in the Mining and Industrial Work Environment Nov 1981.

5. Cochrane, T.S. et al., "Comparison of dust sampling instruments"; Mines Branch Report RR 250; CANMET, Energy, Mines and Resources Canada; October 1971.

6. Spurny, K.R., et al. "Ein schwingbett - aerosol generator für faserigne und pulverförmige stäube"; Zbl Bakt Hyg I Abt Orig B 161; 1976.